

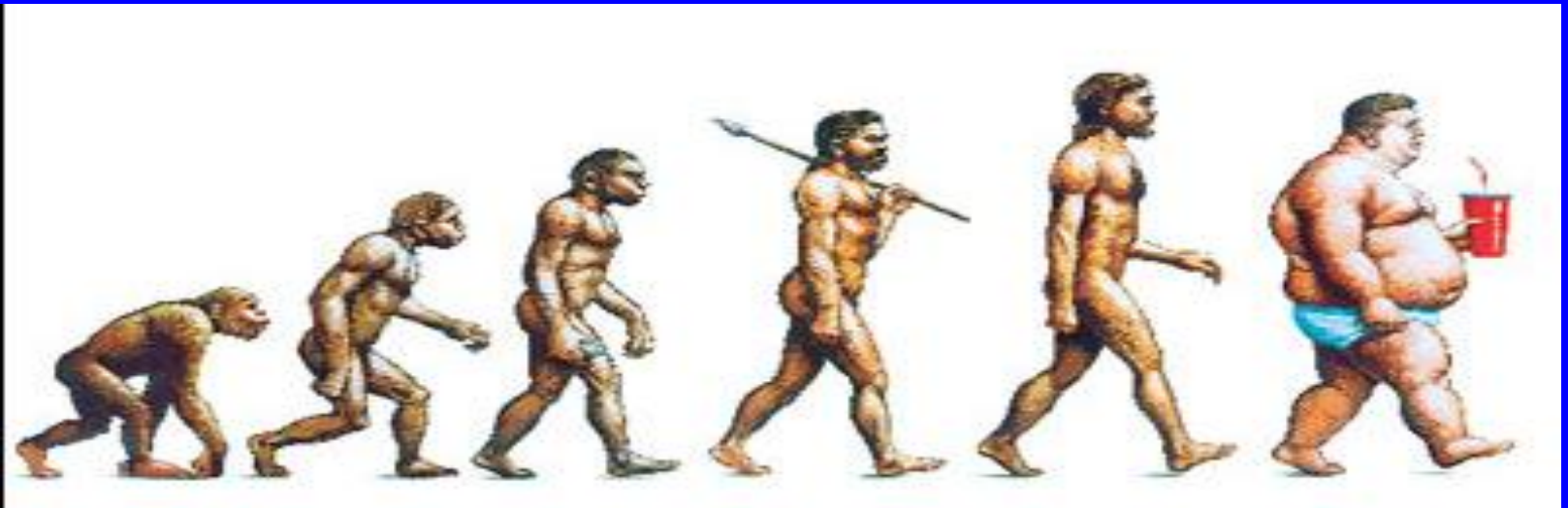
# The Role of Physical Activity in the Management of Diabetes and Heart Disease



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# Evolution of Man



The Economist, December 2003

# Objectives

- Discuss the role of physical activity in the management of diabetes and heart disease
- Review recent clinical trial outcome evidence related to prevention and treatment of diabetes
- Review how to safely integrate physical activity into an overall management plan
- Understand role of medical regimen in physical activity
- Understand how to recognize glycemic response to physical activity
- Understand contraindications to physical activity
- Discuss case studies



# Diabetes and CVD: Two Sides of the Same Coin

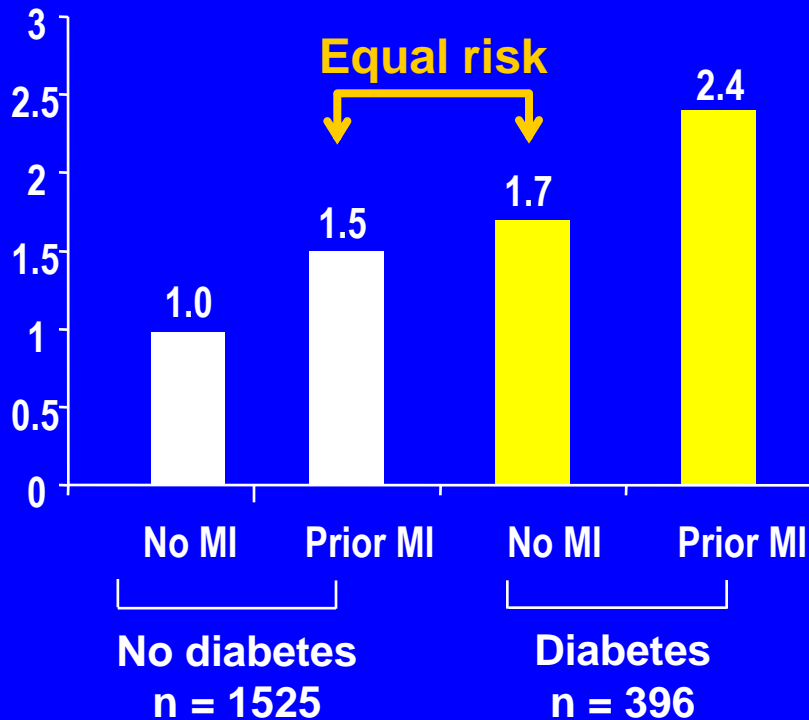
- Diabetes is a CVD equivalent
  - *~70% of patients with diabetes succumb to CVD*
- Among people with clinical CVD
  - *~25% have diagnosed diabetes*
  - *~25% have undiagnosed diabetes*
  - *~25% have prediabetes*
  - *Some proportion of the remainder are*
- *certainly insulin resistant or have metabolic syndrome*  
People present with CVD both before and after the diagnosis of diabetes

# Type 2 Diabetes and Prior MI Predict Mortality Equally

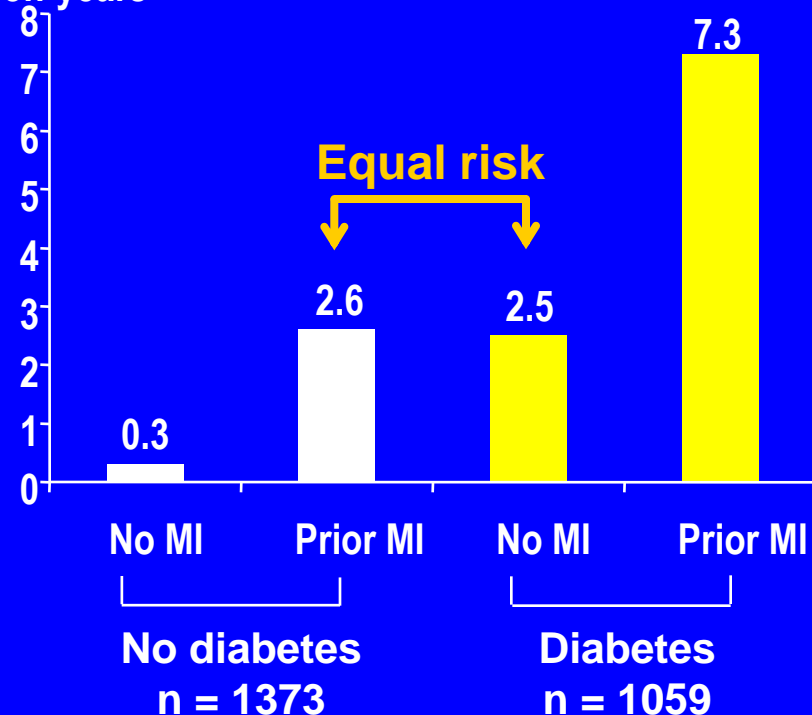
Myocardial Infarction Onset Study  
Adjusted total mortality after MI

San Antonio Heart Study  
Adjusted CV mortality

Hazard ratio



Events per 100  
person-years



Haffner SM et al. *N Engl J Med.* 1998;339:229-234

Mukamal KJ et al. *Diabetes Care.* 2001;24:1422-1427



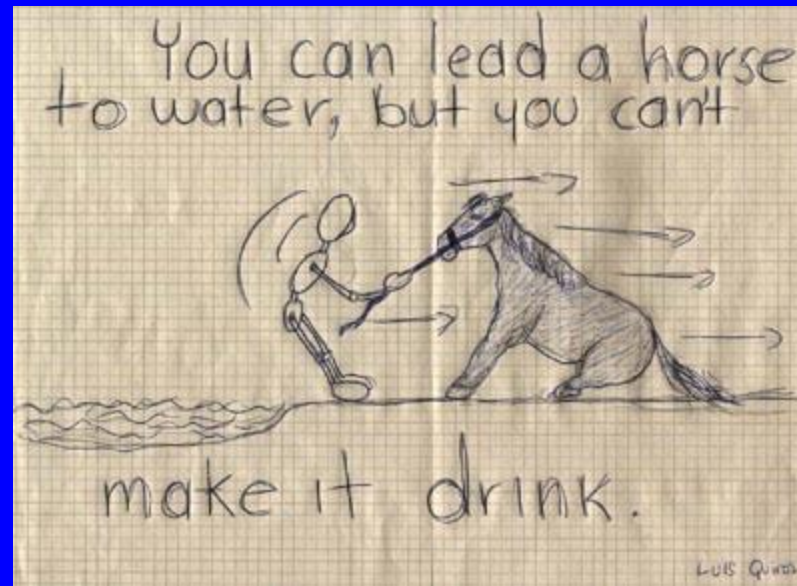


# Public Awareness

## Market Research

- Roper ASW survey of 2,000 PWD in fall 2001
- Findings reinforce need for campaign:
  - *68% do not consider CVD a complication of DM*
  - *3/4 surveyed have other CVD risk factors, but don't relate it to their diabetes*
  - *50%+ do not recognize a personal risk for heart disease or stroke*
  - *60% don't feel at risk for HTN or cholesterol*

# Question: How do you make your patient exercise?



# Case study

- 52 y.o. African American female with T2DM x 3 years
- Weight – 91 kg      BMI – 30      BP - 134/87
- Treated with metformin 1000 mg twice daily and glipizide ER 10 mg daily
- Labs: A1c = 7.3%
  - TC 255, TG 204, HDL 35, LDL 129
  - Creatinine 1.2
  - microalbumin/creatinine ratio 128
- PMH: HTN, Dyslipidemia, no known CAD
- SH: married with 2 adult children, 2-3 beers on weekends, no tobacco, not physically active. Did not graduate H.S. Works as a cashier at Wal-Mart
- Meds: enalapril 10 mg qd, simvastatin 20 mg qhs



# Case Study

What are her CV risk factors?

- BMI
- HTN
- LDL
- Microalbuminuria
- Inactivity

What do we need to do?

- Loose weight
- Add med
- Increase statin
- Increase ACE-I
- Counsel her on benefits of physical activity

# Prevalence of Regular Physical Activity Among Adults United States, 2001 and 2005 (BRFSS)

## Education Level

	Male (%)	Female (%)
< HS	37.2*	37.1*
HS	47.9	43.2
Some college	50.3	47.9
College graduate	54.6	53.3

## Race/Ethnicity

	Male (%)	Female (%)
NHW	52.3	49.6
NHB	45.3	36.1*
Hispanic	41.9*	40.5
Other	45.7	46.6

# Physical Activity...

## The Cornerstone of Diabetes Management



aerobic



resistance

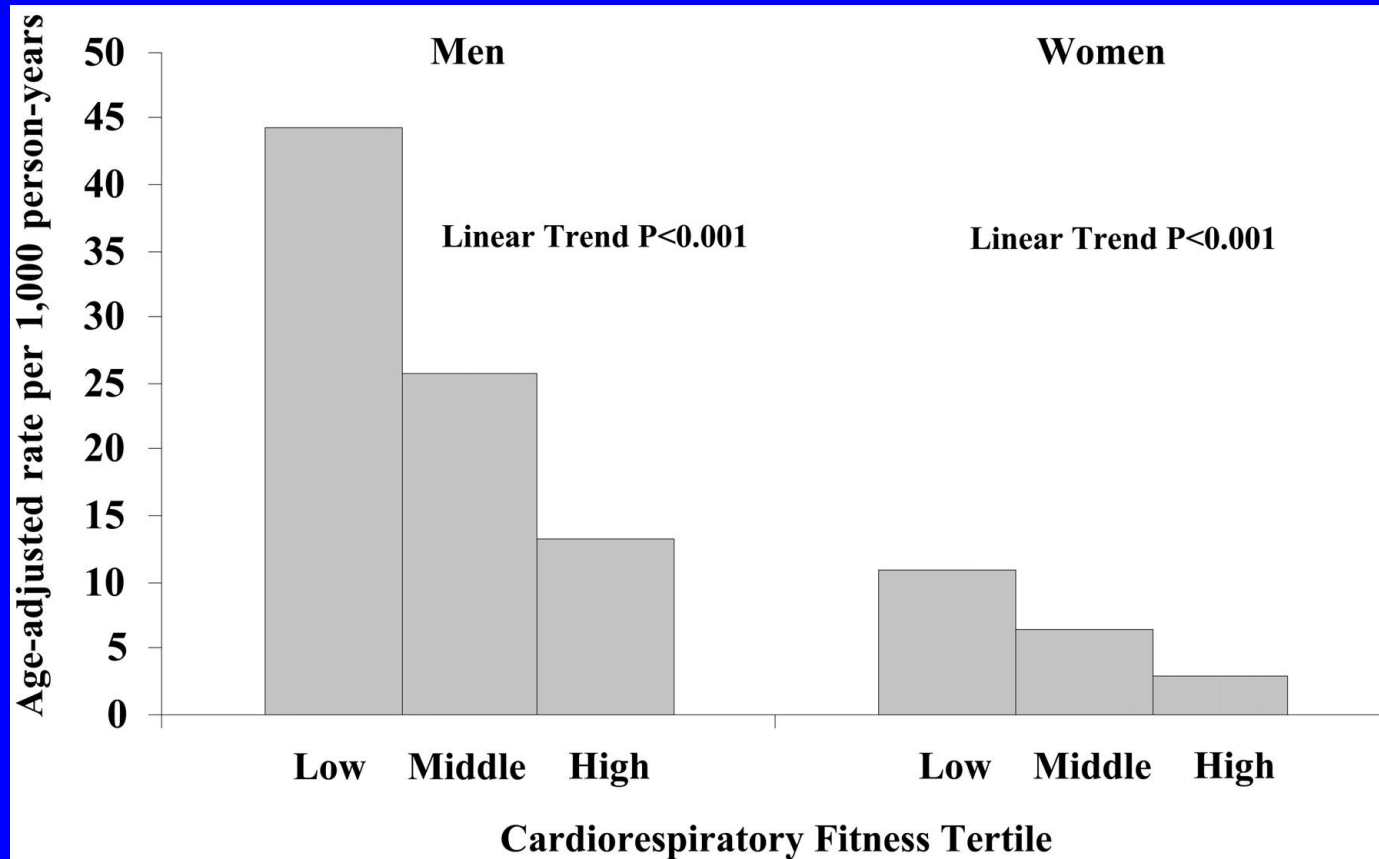
# Macrovascular Benefits

(The Magic Pill)

Well Known:

- reduces blood pressure
  - reduces total cholesterol, raises HDL cholesterol, reduces triglycerides
  - enhances fibrinolysis
  - reduces platelet adhesiveness
- 
- Inverse relationship between fitness and mortality in T2DM men Church, T., Diabetes Care 27:83-88, 2004.

## Age-adjusted incidence rates (per 1000 person-years) of metabolic syndrome by thirds of cardiorespiratory fitness in men and women



LaMonte, M. J. et al. *Circulation* 2005;112:505-512

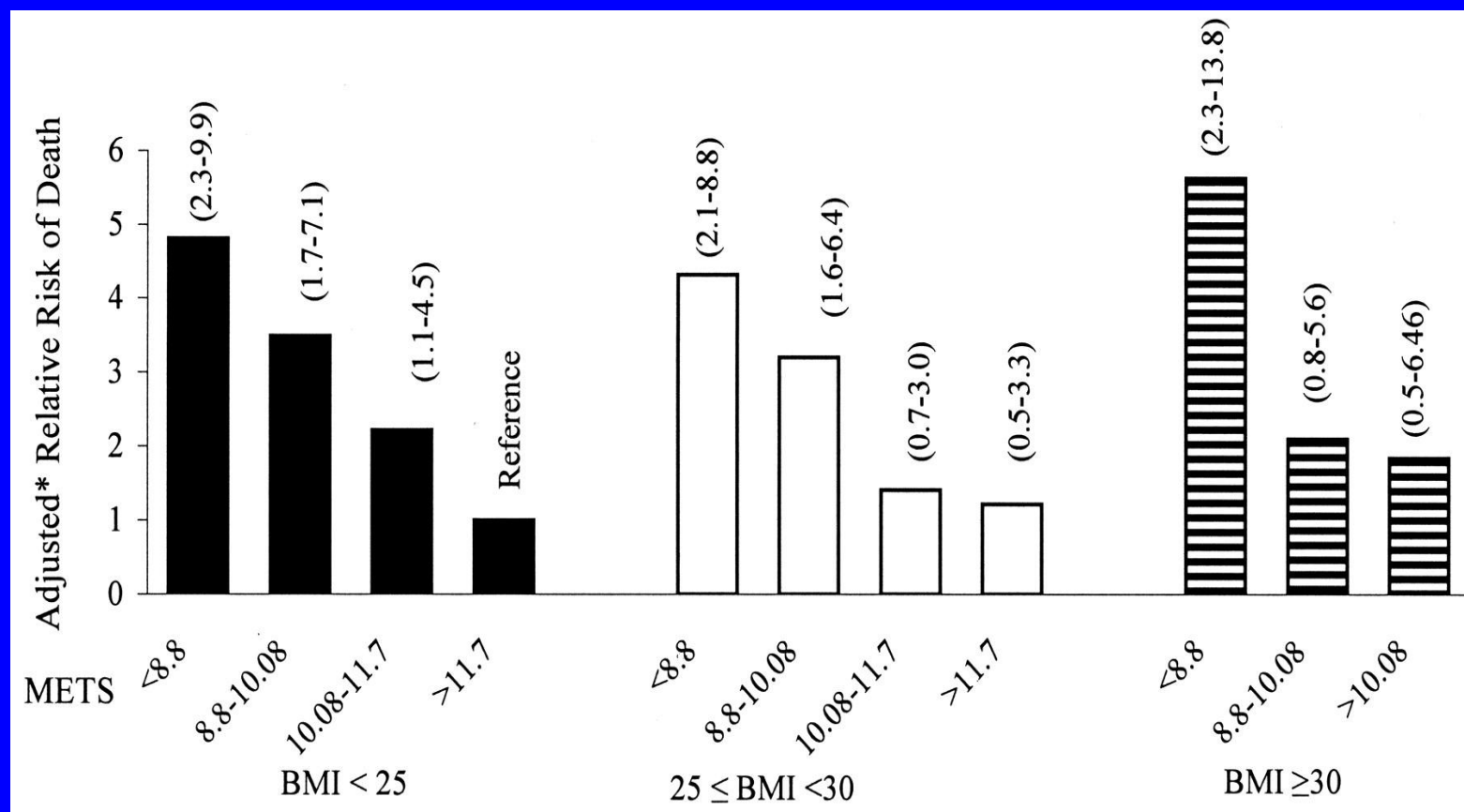


# Relative Risk for Mortality by Fitness Level in Men with Type 2 Diabetes

<i>Relative Risk (95% CI)*</i>		
<i>Fitness Level</i>	<b>C V D</b>	<b>A l l - c a u s e</b>
<i>L o w</i>	1.0	1.0
<i>M o d e r a t e</i>	0.4 (0.3 - 0.7)	0.4 (0.3 - 0.6)
<i>H i g h</i>	0.3 (0.2 - 0.6)	0.2 (0.1 - 0.4)

**\*Adjusted for age and examination year**

# Extended follow up from same study



Church TS et al, Diabetes Care 2004;27:83-88.

# Physical Activity and Prevention of Diabetes

- Finnish Prevention Project: 63–65%
- Diabetes Prevention Project: 58%
- Da Qing: 42-46%

# Benefits For Those With Diabetes

↓ Body Fat %

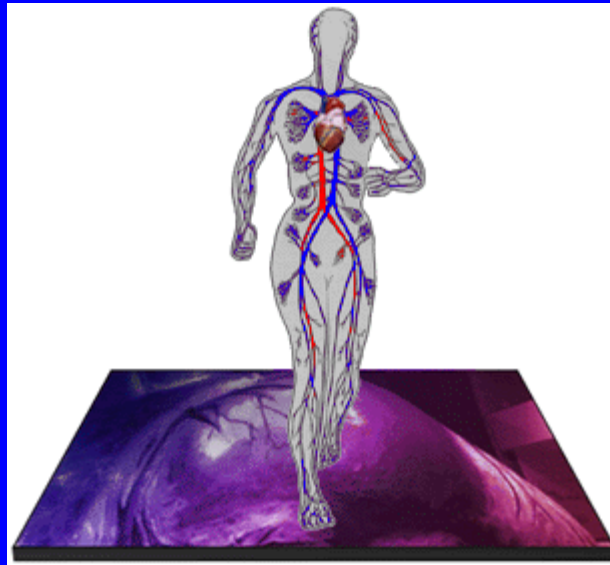
↑ Weight Loss

↑ Insulin Sensitivity

↓ Fasting Glucose Levels

↑ Self Confidence

↑ Well Being



**Improved Glycemic Control**

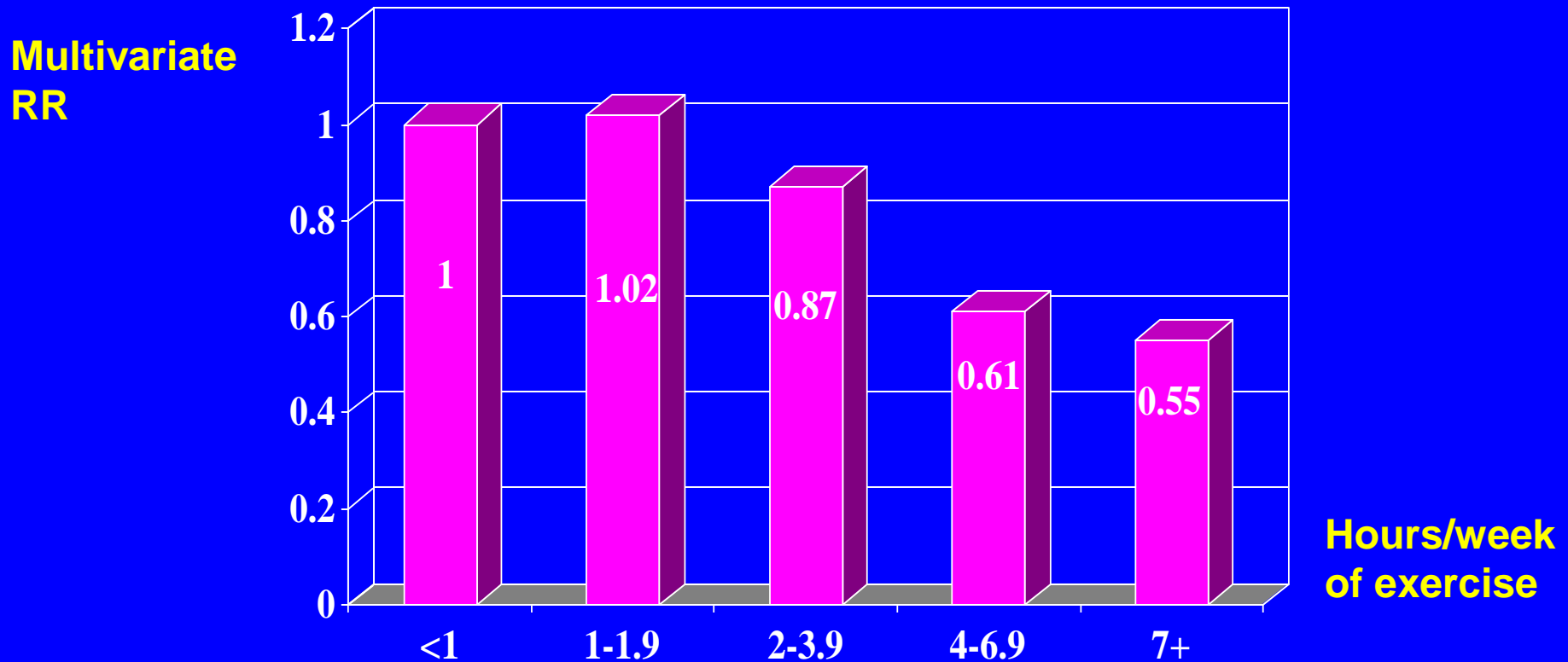
# Successful Weight Loss Maintenance: National Weight Control Registry

## Behaviors Associated With Success

- High level of physical activity (~1 h/d)
- Low-fat, high-carbohydrate diet
- Regular self-monitoring of weight and food intake
- Eating breakfast regularly



# Weekly hours of exercise and risk of CVD in women with DM



Hu FB Ann Intern Med 2001

RR adjusted for age, smoking, BMI, menopausal status, HRT use, vitamin use, parental hx MI<age 60, EtOH consumption, hypertension, cholesterol, ASA use

# DARE

	<b>A1c Baseline</b>	<b>Mean A1c 6 months</b>	<b>Absolute <math>\Delta</math> A1c</b>	<b>P value</b>
<b>Combined</b>	<b>7.46</b>	<b>6.56</b>	<b>- 0.9</b>	
<b>Aerobic</b>	<b>7.41</b>	<b>6.98</b>	<b>- 0.43</b>	
<b>Resistance</b>	<b>7.48</b>	<b>7.18</b>	<b>- 0.3</b>	
<b>Control</b>	<b>7.44</b>	<b>7.51</b>	<b>+ 0.07</b>	
<b>Combined vs Control</b>			<b>0.51</b>	<b>.007</b>
<b>Resistance vs Control</b>			<b>0.38</b>	<b>.038</b>
<b>Combined vs Aerobic</b>			<b>0.46</b>	<b>.014</b>
<b>Combined vs Resistance</b>			<b>0.59</b>	<b>.001</b>

# Action For Health in Diabetes (AHEAD)

- 1° objective: reduction in CVD through weight loss (~7%)
- ILI: home based goal - minimum of ~ 175 minutes/week of moderate intensity
- DSE: education
- Included toolbox similar to DPP

# AHEAD – 1 Year Results

	<b>Weight loss (%)</b>	<b>Mean fitness</b>	<b>Δ A1C</b>	<b>% &lt;7%</b>
<b>ILI</b>	<b>8.6%</b>	<b>+ 20.9%</b>	<b>-0.7%</b>	<b>+26.4%</b>
<b>DSE</b>	<b>0.7%</b>	<b>+ 5.8%</b>	<b>-0.1%</b>	<b>+5.4</b>
<b>P value</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>	<b>&lt;0.001</b>

# AHEAD: 1 Year Results

	BP < 130 SBP	LDL < 100 mg/dl	ALL 3 GOALS
ILI	+15.1%	+ 6.7%	+ 12.8%
DSE	+ 7.0%	+ 8.0%	+ 6.5%
P value	< 0.001	0.34	< 0.001



# **ADA Recommendations: Aerobic & Resistance Exercise**

- **People with diabetes should be advised to perform at least 150 min/week of moderate-intensity aerobic physical activity (50–70% of maximum heartrate). (A)**
- **In the absence of contraindications, people with type 2 diabetes should be encouraged to perform resistance training three times per week. (A)**

# Strategies for Increasing Physical Activity

- **Ensure safety**
  - careful history, exam and therapy for complications
    - insensate foot
    - proliferative retinopathy or macular edema
    - unrecognized vascular disease
  - instruct on hypoglycemia recognition and therapy
- **Modest mutually agreeable interventions**
  - patient willing and able to make changes
  - activity “prescription”
- **In the long run:**
  - 30+ minutes
  - modest intensity
  - Most days of the week

# Pre Exercise Program Evaluation

- Candidates for cardiac testing include those with typical or atypical cardiac symptoms and an abnormal resting ECG
- Screening of asymptomatic patients is not recommended
- Assess CVD risk factors
- Use clinical judgment
- Start low and go slow

# Proper Preparation

*What you should tell them to do:*

- ☑ self monitoring blood glucose (SMBG)
- ☑ warm up and cool down
- ☑ wear proper shoes and inspect feet daily
- ☑ wear alert bracelet
- ☑ carry extra carbohydrate

# Role of Record Keeping in Evaluating Response to Activity

- SMBG patterns provide day-to-day data used to design and implement physiologic medical regimen and carbohydrate adjustments to ultimately improve outcome
- should include:
  - medication reduction
  - CHO intake
  - duration & intensity
  - BG response

# Self Monitoring Blood Glucose Log

Fasting	Lunch	Supper	Bed
99			182
140		211	134 (after EX)
102			
137		195	127 (after EX)

# Continuous Glucose Monitors

Medtronic



Dexcom



Abbott



# Anti Diabetic Agents

## Increase Insulin Secretion

Amaryl, Glucotrol, Glyburide,  
Prandin, Starlix



Can Lower Glucose  
with Exercise

Avandia  
Actos  
Glucophage  
Byetta  
Januvia



Will Not Lower Glucose  
with Exercise

Insulin



Will Lower Glucose  
with Exercise



# Insulin and Carbohydrate Adjustments

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Based on:

- duration, intensity, frequency
- time since last insulin injection / bolus
- time since last meal and type of meal
- fitness level
- your priorities
- recent hypoglycemia/ physical activity
- male vs. female
- duration of diabetes

# General Guidelines

- The higher the duration, intensity, and / or frequency, the more you need to reduce the insulin, or increase supplemental CHO that will be acting at the time of exercise.
- The less trained the person is at a specific activity, the more likely they are to experience hypoglycemia.

# Guidelines for insulin and CHO adjustments based on duration and intensity of exercise

intensity	duration		
	short	medium	long
Low	<b>0-10%</b>	<b>0-20%</b>	<b>10-20%</b>
moderate	<b>0-10%</b>	<b>20-30%</b> + 15-25 gm/CHO/hr	<b>30-50%</b> +25-50 gm/CHO/hr
high	<b>0-20%</b>	<b>30-50%</b> + 25-50 gm/CHO/hr	<b>30-60%</b> +50-80 gm/CHO/hr

# Preventing Hypoglycemia



Frank discovered one of the many pitfalls of treating low blood sugar at three o'clock in the morning.

# Who is at risk for Hypoglycemia?

- weekend warriors or untrained person
- increased duration, intensity and/or frequency
- new activity
- insulin especially longer acting forms
- older sulfonylureas
- alcohol use
- hypoglycemia unawareness
- Recent physical activity or hypoglycemia within last 24 hours

# Preventing Hypoglycemia:

- frequent monitoring
- consuming extra carbohydrates when necessary
- keeping accurate records of duration, intensity, and frequency
- reduction of insulin that is active at time of exercise

# Hyperglycemia and Ketones

- Insulin deficiency leads to hyperglycemia and may lead to ketoacidosis
- If BG > 250 mg/dl - check ketones

# Complications and Risk of Injury

- Neuropathy
- Retinopathy
- Nephropathy
- Cardiac
- Foot ulcers
- Hemorrhages
- None
- MI, Sudden Death,
- Arrhythmia
- hypotension/hypertension



# Exercising with Neuropathy

## Indicated

- ☐ swimming
- ☐ water aerobics
- ☐ bicycling
- ☐ chair exercises

## Contraindicated

- jogging
- prolonged walking
- step aerobics
- treadmill

# Case study

- 67 y.o. female with T2DM, otherwise in good health
- Treated with metformin 850 mg twice daily and glyburide 10 mg twice daily
- A1c = 7.3% Weight 188 BMI 27
- Has begun LMT with low CHO diet and a walking program 9 weeks ago
- Started at 15 minutes every other day and is now walking 45 minutes a day after breakfast

## Case Study (cont'd)

- She has lost 6 lbs and is feeling more energetic
- She c/o fasting hypoglycemia twice a week
- A1c is now 6.8%

QUESTION: WHAT DO YOU DO?

On further questioning, she is eating HS snack to prevent hypos

# Case Study... What Changes Can Be Made?



- Female soccer player wearing an insulin pump
- Frequent weekend tournaments up to three games a day
- BG ok on Saturdays but struggles with low BGs on Sunday

# Case – The Early Morning Workout

- 48 yo male pumper
- Likes to work out early morning before breakfast
- Mixed aerobic- resistance workout for ~ 90-120 minutes
- Disconnects pump prior to workout
- Complains that he is always high after the workout (~ 200 mg/dl)
- QUESTION: what does he need to do?

# Resistance Training

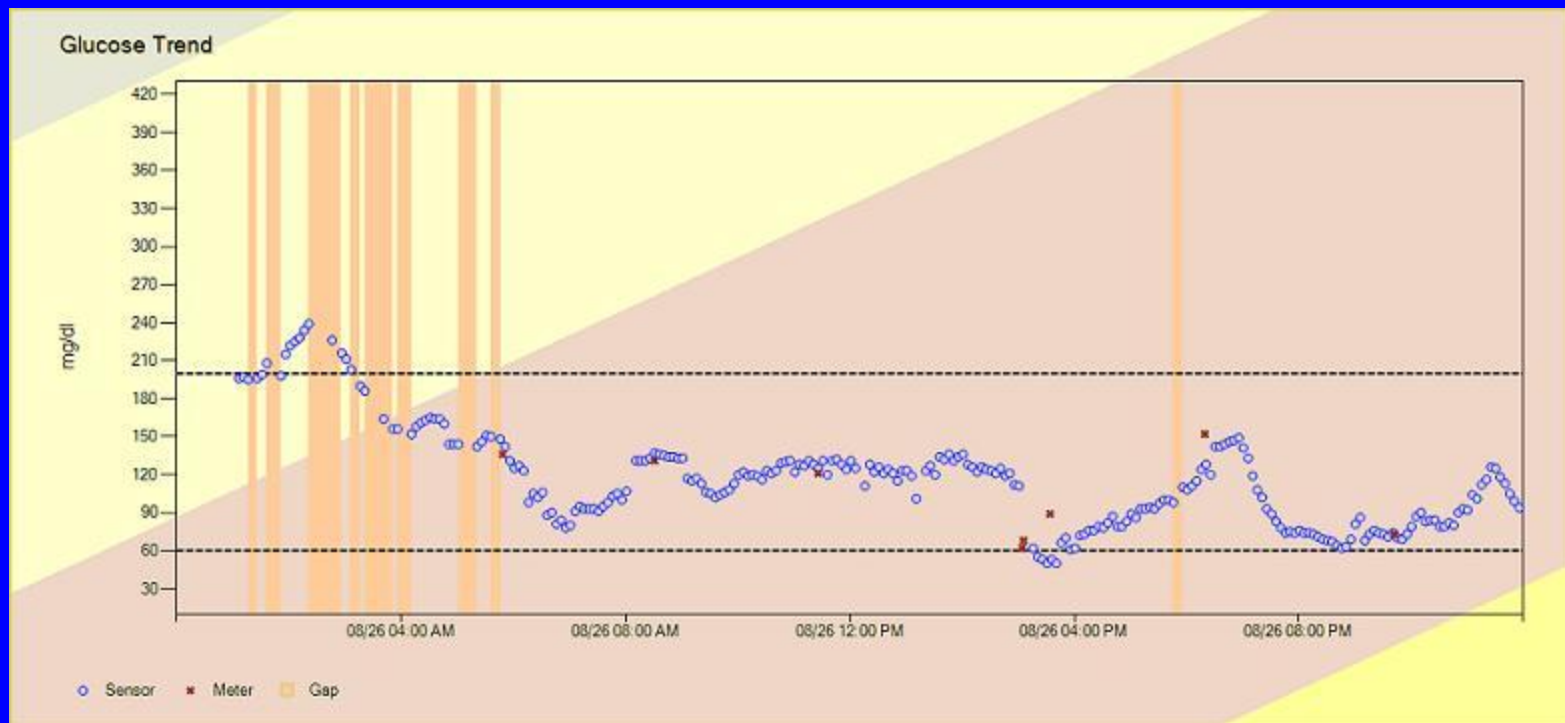
- If performed alone usually does not lead to a decline and possibly an increase in BG
- If performed together with aerobic exercise the aerobic exercise may nullify the increase in BG

## 24 Hour MTB racer (Solo)

- Pumper + CGM
- BG during race between 75-162
- Basal reduction ~55-65%
- CHO 50-75 gm/hr
- 24 Hours of Burn –  
total of 90 miles with  
10K ft of climbing



# Solo 24 Hour Mountain Bike Race (First 12 hours)







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